REMARKS

This amendment is responsive to the Office Action of February 24, 2004. Reconsideration and allowance of claims 1-27 and 29-32 are requested.

Numbering of Claims

Applicants note that the claims were incorrectly numbered (two claims 22) and request that the Examiner renumbers the claims as shown.

The Restriction Requirement

A restriction requirement was made between group I, claims 1-14, drawn to a battery, group II, claims 15-25, drawn to a method of conducting a reaction, group II, claim 26 (now claim 27), drawn to a metal sponge, and group IV, claim 27 (now claim 28), drawn to a metal sponge. Applicants confirm their election of group I, claims 1-14, without traverse.

Claim 15 has been amended to depend from claim 7. It is respectfully requested that, should an allowable claim be identified, rejoinder of claims 15-26 be permitted. Claim 27 has been amended to recite a battery comprising the sponge. Accordingly, it is respectfully requested that claim 27 be rejoined.

The Drawing Objections

The drawings were objected to for failing to include FIGURES 11A, 11B, 11C, and 11D. Applicants include herewith a proposed drawing page showing these FIGS. An informal drawing showing these pages was present in the originally filed PCT application from which the present application claims priority. Applicants have taken the liberty of submitting revised formal drawings with page numbers incorporating this page of drawings.

The Claim Rejections

Claims 1-4, 6, 8, 10, and 12-14 were rejected under 35 U.S.C. §102(e) as being anticipated by Bando, et al. (U.S. Patent No. 5,965,295).

Claim 7 was rejected under 35 U.S.C. §102(e)/103(a) as being anticipated by/unpatentable over Bando, et al.

Claims 5 and 9 were rejected under 35 U.S.C. §103(a) as being unpatentable over Bando, et al. in view of Reichman, et al. (U.S. Patent No. 6,171,726) and/or Kimiya, et al. (U.S. Patent No. 6,013,390).

Notice of Copending Application

Applicants wish to draw the Examiner's attention to the following related application, and references cited therein:

Application Serial No. 10/182,927, filed August 2, 2002 (Attorney Docket No. CWRZ 200274).

The Claims Distinguish over the References of Record

Claim 1 has been amended and now recites a battery including an anode, a cathode, and an electrolyte. At least one of the anode and cathode includes an electrically conductive sponge material. The electrically conductive sponge material defines dendrites having a width of less than 1 micrometer.

Support for the amendments to claim 1 are to be found in the specification at page 6, lines 3-5.

Having a width in the claimed range provides a large surface area which allows a large surface area for contact of an electrolyte. As noted in the specification, the electrical resistance of a layer is inversely proportional to its surface area. By providing a large surface area, the resistance of the anode or cathode can be substantially reduced and the battery power increased. The large contact area provided by dendrites of 1 micrometer or less increases the power of the battery by orders of magnitude over what is conventionally achieved.

Bando, et al. does not disclose or fairly suggest dendrites having a width of less than 1 micrometer. The two-dimensional substrate 22 of Bando may be formed by rolling a powder to form a plate having a large number of openings 21. The pore dimensions may be 2mm by 2mm (col. 33, lines 7-9). A three dimensional substrate 23 is applied to the plate. As noted in column 11, lines 39-60, the three dimensional substrate is formed by impregnating a urethane foam with a nickel powder-containing solution. The foam is then thermally decomposed. Such a process would not yield dendrites of the fineness claimed. Urethane foams have relatively large pores, which, when filled with the nickel powder-containing solution, would yield a sponge-like nickel porous body having structures of similar widths to the pores of the urethane foam. Thus, Bando's method would not yield dendrites of the width claimed nor have the advantageous properties which can be realized with such fine dendrites.

Reichmann, et al. and Kimiya, et al. which were cited against dependent claims 5 and 9, do not supply the deficiencies of the primary reference. Neither Reichmann nor Kimiya discloses a battery comprising dendrites having a width of less than 1 micrometer.

Accordingly, it is submitted that claim 1, and claims 2-5, 8-9, and 4 dependent therefrom, distinguish patentably and unobviously over the reference of record.

Claim 6 has been placed in independent form and now recites a battery which includes an anode, a cathode, and an electrolyte therebetween. At least one of the anode and cathode includes a substrate and an electrically conductive sponge material. The sponge material is in the form of particles of sponge attached to the substrate.

Support for the amendments to claim 6 are to be found in the specification at page 16, lines 12-14.

Bando makes no suggestion of an electrically conductive sponge material which is in the form of particles of sponge attached to a substrate. Bando's three-dimensional substrate is formed by infiltration of a foam and thermally decomposing the foam. The result is a relatively coarse material which does not possess the large accessible surface area which can be achieved by forming particles of a foam and attaching these to a substrate. Having a large surface area has several advantages. For example, as noted in the specification, resistance is inversely proportional to the surface area. By providing a large surface area, the resistance of the anode or cathode can be substantially reduced and the battery power increased.

Accordingly, It is submitted that claim 6 distinguishes patentably and unobviously over the references of record.

Claim 7 has been placed in independent form and recites a battery including an anode, a cathode, and an electrolyte therebetween. At least one of the anode and cathode includes a substrate and an electrically conductive sponge material. The sponge material is in the form of a layer of sponge grown on the substrate.

The Examiner acknowledges that Bando does not disclose that the three-dimensional substrate is grown on the two-dimensional substrate. This is clearly the case as there is no suggestion as to how a three dimensional substrate could be so

grown and yet provide a seal for Bando's paste which is held in place by the three dimensional substrate.

In the present case, growing a sponge on a substrate enables a surface of extremely fine dendrites to be formed and thus provides a large surface area, which is not achievable with the method of Bando. Additionally, being grown from the substrate, the present dendrites have good electrical contact with the substrate. This permits a battery to have a power which is orders of magnitude higher than can be conventionally achieved. Bando's three dimensional substrate 23 makes only point contact with the two dimensional substrate 21 and thus conductivity is low. Additionally, the thick paste which is trapped between the two dimensional substrate and the three dimensional substrate of Bando is a relatively poor conductor. Bando attempts to improve conductivity by incorporating a conductor, such as cobalt, into his paste, but even with such conductivity aids, the battery cannot come close to achieving the power available with the presently claimed grown sponge. Applicants have calculated that for a nickel electrode formed according to the present method, a resistance of approximately 10^{-6} that of Bando's (i.e., about 1 millionth), or even less is achieved using a grown sponge. Lowering the resistance allows much higher power levels to be achieved.

Accordingly it is submitted that claim 7, and claims 10-13, and 15-26 dependent therefrom, distinguish patentably and unobviously over the references of record.

New claim 29 recites a battery including an anode, a cathode, and an electrolyte. At least one of the anode and cathode includes an electrically conductive sponge material. The electrically conductive sponge material defines dendrites. A layer of a different material is on the dendrites which spaces the dendrites from the electrolyte. Support for new claim 29 is to be found in claims 1 and 10, as originally filed, in the specification at page 5, lines 18-21.

New claim 30 recites the battery of claim 29 and wherein the sponge defines pores having a pore width of less than 30 micrometers, the layer of a different material covering the sides of the pores to provide a passage for access of the electrolyte.

Support for claim 30 is to be found in the specification at page 6, lines 7-8, page 7, lines 26-31, and in FIGURE 2.

Bando does not suggest a battery in which a layer of a different material

spaces dendrites from an electrolyte. In Bando, the thick paste is trapped between the layer 21 and the layers 23.

The layer of a different material provides an active surface at which electrochemical reactions involving the electrolyte can take place. Because the layer spaces the dendrites from the electrolyte, it can follow the contours of the dendrites, as illustrated in FIGURE 2, and thus have an extremely large surface area on which the reactions can take place. As discussed above, having a large surface area provides increased power. Because of the large area, the layer can be thin, which reduces the path length through the material and further reduces resistance losses.

This is very different from Bando's thick paste which provides a high resistance and a relatively low surface area.

New claim 32 recites a battery including an anode, a cathode, and an electrolyte. At least one of the anode and cathode includes an electrically conductive sponge material the electrically conductive sponge material defining dendrites., the sponge having a surface area of at least $40m^2/cm^3$.

Support for new claim 31 is to be found in claims 1 and 10, as originally filed, in the specification at page 4, line 8-10, and at page 6, lines 3-5. The example given on page 4 demonstrates that dendrites of average width of 100 nm have a specific surface area of 40 m^2/cm^3. On page 6, lines 5-7 it is noted that the surface area can be up to several hundred m^2/cm^3.

Bando does not disclose such a high surface area. Bando's three dimensional substrate needs large access regions to allow a thick paste with large particles of nickel hydroxide (5-30 micrometers, see col. 6, lines 63-64) to enter. Bando's three dimensional substrate has a weight per unit area of 50-300 g/m^2 (equivalent to 0.02-0.003 m^2/g). However, at least 90% of the Bando material is void. Thus, for nickel, which has a density of about 9 g/cm^3, i.e., 0.9 g/cm^3 where the material is only 10% solid, Bando's material has a surface area of only about $3\text{-}20 \times 10^{-3}$ m^2/cm^3. Where the void volume is higher, slightly higher surface areas may be achieved, but not close to the 40 m^2/cm^3 presently claimed.

Since resistance for a given resistivity and length is inversely proportional to surface area, the lowest resistance which can be achieved by Bando's structure is many orders of magnitude higher than can be achieved with the presently claimed sponge.

Accordingly, it is submitted that claim 32 distinguishes patentably and unobviously over the references of record.

CONCLUSION

For the reasons set forth above, it is submitted that claims 1-27 and 29-32 distinguish patentably over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, she is requested to telephone Ann M. Skerry at (216) 861-5582.

Respectfully submitted,

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15 June 2004

Date

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Certificate of Mailing

Under 37 C.F.R. § 1.8, I certify that this Amendment is being

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	C M Kobylinski
Date	**Printed Name**
15 JUNE 2004	**Cheryl M. Kobylinski**

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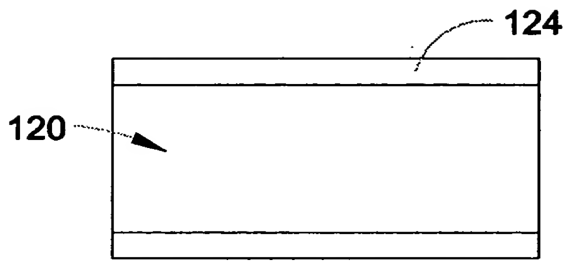

FIG. 11A

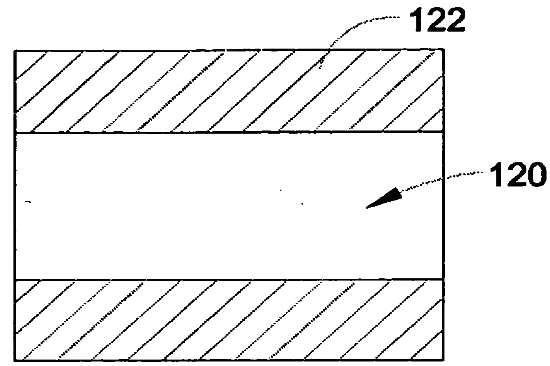

FIG. 11B

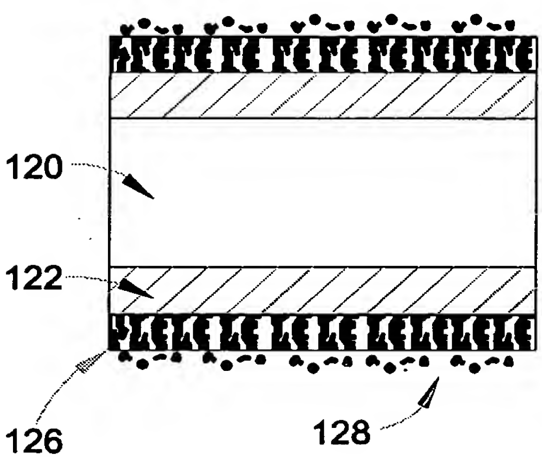

FIG. 11C

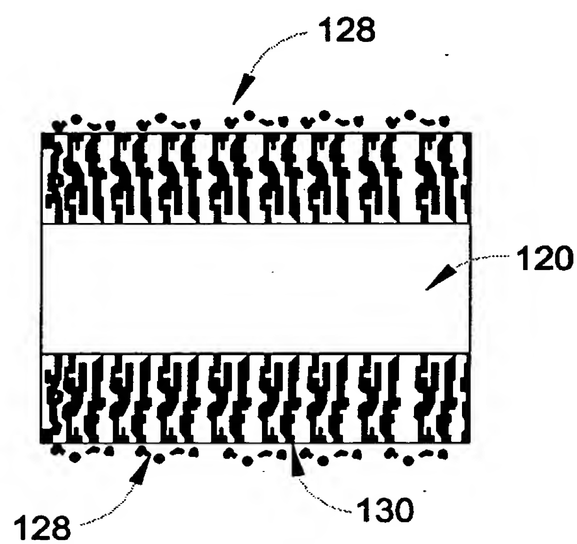

FIG. 11D

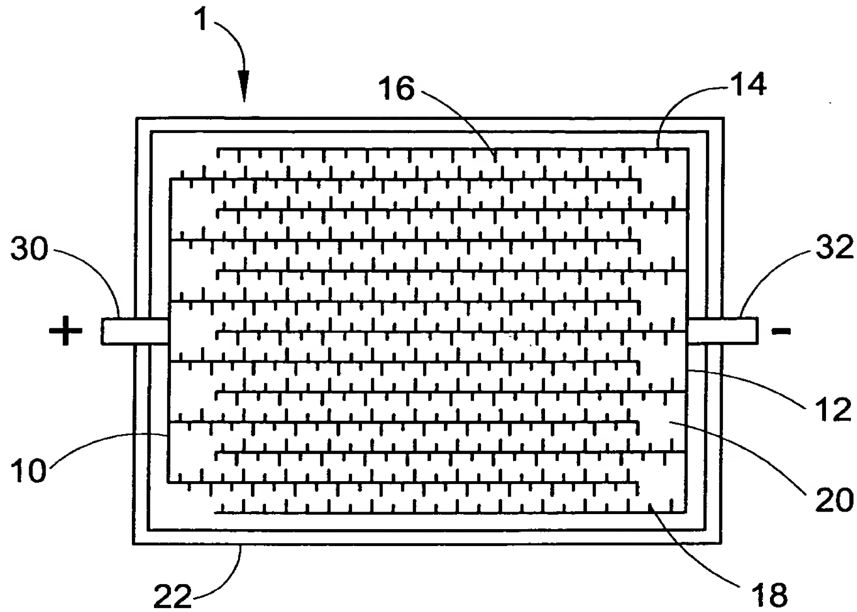

FIG. 1

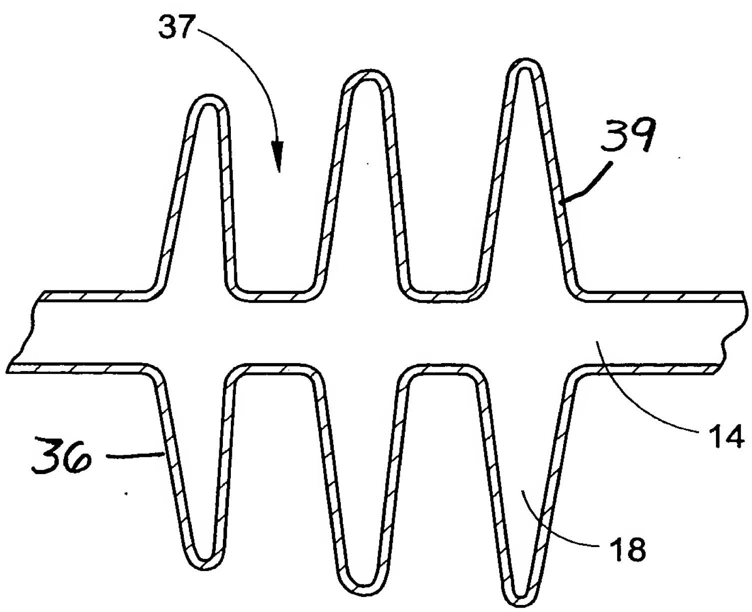

FIG. 2